

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
4 November 2004 (04.11.2004)

PCT

(10) International Publication Number
WO 2004/095887 A1

(51) International Patent Classification⁷: **H05B 33/08**,
G01R 19/00

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,
ZW.

(21) International Application Number:
PCT/GB2004/001670

(22) International Filing Date: 16 April 2004 (16.04.2004)

(25) Filing Language: English

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Euro-
pean (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,
GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

(26) Publication Language: English

(30) Priority Data:
0308815.0 16 April 2003 (16.04.2003) GB

Declaration under Rule 4.17:

— of inventorship (Rule 4.17(iv)) for US only

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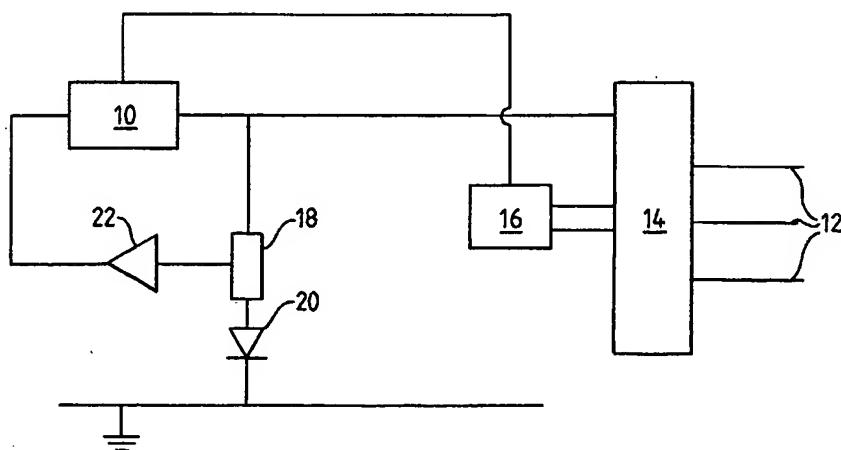
Published:

— with international search report

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For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS AND METHOD FOR OPERATING CURRENT DEPENDENT ELECTRONIC DEVICES



(57) Abstract: An apparatus for operating one or more electronic devices requiring a given current is described, which comprises a regulator device (10) providing voltage output, and a feedback loop having a reference device connected to the voltage output and requiring the same current as the electronic devices, a measuring and conversion device operable to measure the current through the reference device and convert it to a voltage value and return it to the regulator device (10), wherein the regulator device (10) is operable to adjust the output voltage in response to the voltage value until the measured current is equal to the given current required.

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APPARATUS AND METHOD FOR OPERATING CURRENT DEPENDENT
ELECTRONIC DEVICES

The present invention relates to an apparatus and
5 method for operating one or more electronic devices which
require a constant given current. In particular, the
invention concerns operating a number of current devices
such as light emitting diodes (LEDs) mounted on
conductive strip to provide an elongate lighting strip.

10

Such lighting strips are well-known for example to
mark the way to emergency exits on aircraft. They
comprise a plurality of LEDs mounted at intervals along a
conductive strip encased in plastic. LEDs, in common
15 with a number of other electrical devices, are current
devices, that is they rely on a constant current to
operate, rather than a constant voltage.
The life and brightness of a LED can be maximised by
accurately controlling the current.

20

Known lighting strips have a driver apparatus which
is designed to operate a given number and a particular
type of LED. If the driver is used on a strip having a
different number of LEDs or a different type of LED, then
25 the drive apparatus must be completely reset which is a
time-consuming, awkward and inefficient process.

The present invention provides an apparatus for
operating one or more electronic devices requiring a
30 given current, comprising a regulator device providing a
voltage output, and a feedback loop having a reference
device connected to the voltage

output and requiring the same current as the electronic devices, a measuring and conversion device operable to measure the current through the reference device and convert it to a voltage value and return it to the 5 regulator device, wherein the regulator device is operable to adjust the output voltage in response to the voltage value until the measured current is equal to the given current required.

10 In the present invention, use of a reference device of the same type as the electronic device that is to be operated allows the regulator automatically to adjusted to produce an absolute voltage of the appropriate level to drive the remaining devices. In this way, the 15 apparatus is able to produce the correct voltage, automatically compensating for both short and long term drift, for any type and number of electronic devices being used.

20 Preferably, the measurement and conversion device consists of a resistor and a current monitor.

25 The electronic devices are typically light emitting diodes, mounted on a conductive strip having a plurality of conductive elements.

30 The electronic devices may be parallel connected devices which are polarity sensitive, and the regulator may be connected to a three phase bridge to operate the conductive elements in the strip, and a micro controller operable to control the sequence in which the LEDs on the strip are operated.

Preferably, the regulator comprises a steady state DC device.

In a further aspect, the invention also provides 5 apparatus for emitting electromagnetic radiation (EMR) comprising a plurality of electronic devices operable to produce EMR when provided with a given current mounted on a conductive strip which is connected to an apparatus of the type described above.

10

The present invention also provides a method for operating one or more electronic devices requiring a given current, comprising the steps of providing a voltage output, supplying the voltage output to a 15 reference device requiring the same current as the electronic devices, measuring the current in the reference device, converting the measured current to a voltage value and adjusting the voltage output in response to the voltage value until the measured current 20 in the reference device is equal to the given current required by the electronic devices.

Preferably, the method involves initially providing a voltage output sufficient to produce a current lower 25 than the given current and gradually increasing the voltage output until the given current is obtained in the reference device.

The present invention will now be described in more 30 detail, by way of example only, with reference to Figure 1, which is a circuit diagram of one embodiment of apparatus in accordance with the present invention.

The principal feature of the present invention is that an electronic device of the same type as those to be operated is incorporated into a feedback loop of the apparatus. As shown in Figure 1 a regulator device 10 is 5 connected to the electronic devices to be driven. The regulator 10 is preferably, but not exclusively, a steady state DC device for accuracy. In this example, the electronic devices are LEDs (not shown) mounted on a conductive strip having three conductors 12. A three- 10 phase bridge 14 is connected between the regulator device 10 and the conductors 12. The regulator 10 may also be connected to a micro controller 16, itself connected to the three-phase bridge 14, for example to control the sequence of operation of the LEDs in the conductive 15 strip.

The regulator 10 is also provided with a feedback loop. The voltage output from the regulator 10 also passes through a current measuring device such as a 20 resistor 18 and a reference LED 20 of the same type as those in the strip which are to be driven. The resistor 18 is also connected to a current monitor device 22. Together the resistor 18 and the current monitor 22 act to measure the current passing through the reference LED 25 20 and to convert it to a voltage. This is passed back to the regulator 10. Since the desired current for the LEDs in the conductive strip is known from the outset and the reference LED 20 is of the same type as the LEDs to be operated, this feedback loop allows the voltage 30 output from the regulator 10 to be adjusted to the appropriate level so that the desired current is achieved.

In operation, the regulator 10 will initially be set to produce a voltage output which is lower than that required to provide the desired current. The current through the reference LED 20 is then measured as the 5 voltage output is gradually increased until the desired current through the reference LED 20 is achieved. At this point, the voltage output from the regulator 10 will be at the right level to operate the LEDs in the lighting strip in an optimum manner.

10

Another important feature of the lighting strip of the preferred embodiment of the present invention is that it is directly driven by a controlled voltage source thus removing the requirement for resistors within the 15 lighting strip itself. Removal of the resistors from the lighting strip reduces the capacity for the lighting strip to heat up and consequently reduces the power consumption of the lighting strip.

20

Certain applications may also require minimisation of Electro Magnetic Compatability (EMC) interference for use in particularly sensitive environments. The present invention can significantly reduce such interference by providing a standing DC voltage just below the threshold 25 level required to operate the LEDs and superimposing small pulses which raise the voltage above the threshold in order to switch the LEDs on. The switching voltage is thus a fraction of the full operating voltage then and the electro magnetic interference can be significantly 30 reduced. For optimum performance the voltage pulses can have soft edges.

It will be appreciated that a number of modifications and variations to the details described above can be made. For example, if the lighting strip includes LEDs of different colours, the regulator 10 may 5 be provided with separate feedback loops with a reference LED of each colour and the micro controller may be used to control which LEDs are to operate at a given time. In addition, it will be appreciated that the present invention is not restricted to use with conductive strips 10 having LEDs, or indeed to conductive strips having devices which emit visible light. The invention is equally applicable to use with devices producing other wavelengths in the electromagnetic spectrum, whether producing visible light or not.

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The invention provides a simple and efficient manner in which to operate current devices, which is easily adaptable to operating different types and numbers of devices.

CLAIMS

1. Apparatus for operating one or more electronic devices requiring a given current, comprising a regulator device providing voltage output, and a feedback loop having a reference device connected to the voltage output and requiring the same current as the electronic devices, a measuring and conversion device operable to measure the current through the reference device and convert it to a voltage value and return it to the regulator device, wherein the regulator device is operable to adjust the output voltage in response to the voltage value until the measured current is equal to the given current required.
- 15 2. Apparatus as claimed in claim 1, wherein the measurement and conversion device comprises a resistor and a current monitor.
- 20 3. Apparatus as claimed in claim 1 or claim 2, wherein the electronic devices comprises light emitting diodes mounted on a conductive strip having a plurality of conductive elements.
- 25 4. Apparatus as claimed in any preceding claim, wherein the electronic devices are parallel connected and polarity sensitive, and the regulator is connected to a three-phase bridge and a micro controller operable to control the sequence in which the LEDs on the conductive strip are operated.
- 30

- 8 -

5. Apparatus as claimed in any of the preceding claim,
wherein the regulator device comprises a steady state DC
device.

5 6. Apparatus for emitting electromagnetic radiation,
comprising a plurality of electronic devices operable to
emit electromagnetic radiation when provided with a given
current mounted on a conductive strip and connected to
apparatus as claimed in any claims 1 to 5.

10

7. A method for operating one or more electronic
devices requiring a given current comprising the steps of
providing a voltage output, supplying the voltage output
to a reference device requiring the same current as the
15 electronic devices measuring the current in the
reference device, converting the measured current to a
voltage value, and adjusting the voltage output in
response to the voltage value until the measured current
in the reference device is equal to the given current
20 required by the electronic devices.

8. A method as claimed in claim 7, further comprising
the step of initially providing a voltage output
sufficient to provide a current lower than the given
25 current and gradually increasing the voltage output until
the measured current in the reference device is equal to
the given current.

9. Apparatus for operating one of more electronic
30 devices requiring a given current substantially as
hereinbefore described and with reference to the
accompanying drawing.

10. Apparatus for producing electromagnetic radiation substantially as hereinbefore described and with reference to the accompanying drawing.

5

11. A method for operating electronic devices requiring given current as substantially hereinbefore described and with reference to the accompanying drawing.

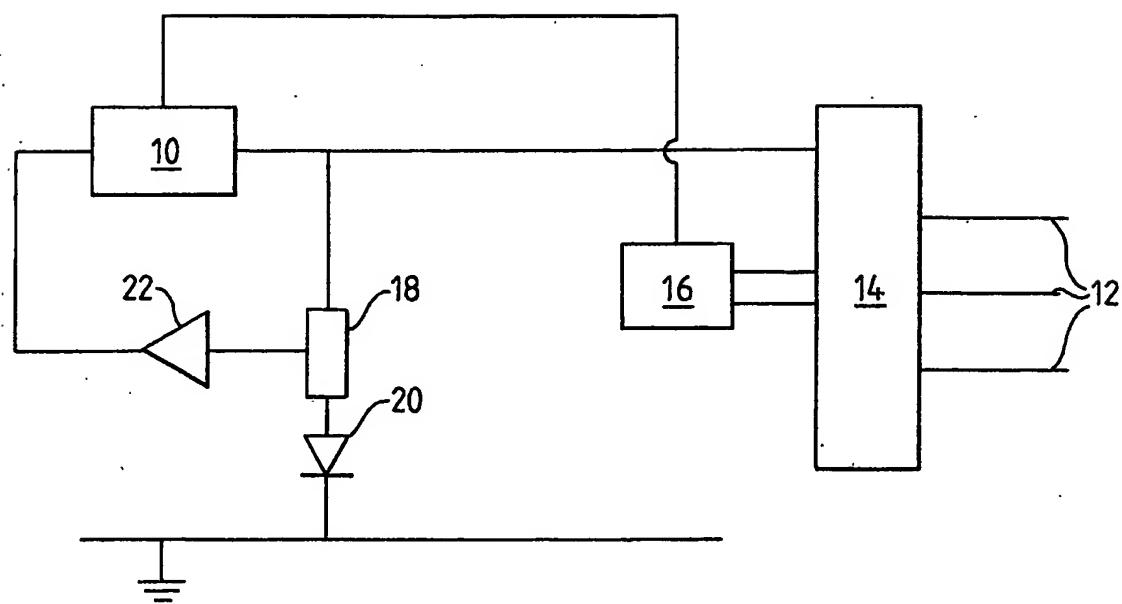


FIG. 1

INTERNATIONAL SEARCH REPORT

national Application No

/GB2004/001670

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H05B33/08 G01R19/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 H05B G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 480 650 A (HEWLETT PACKARD CO) 15 April 1992 (1992-04-15) column 5, line 17 - column 8, line 1; figure 2	1-3,5-7, 9-11
X	US 2002/014862 A1 (FREGOSO GILBERT) 7 February 2002 (2002-02-07)	9-11
A	paragraphs '0017! - '0019!; claim 6; figure 2	1,2,7
X	US 4 952 949 A (UEBBING JOHN J) 28 August 1990 (1990-08-28)	9-11
A	column 3, line 4 - column 6, line 60; figure 1	1,7,8
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the International search

21 July 2004

Date of mailing of the International search report

29/07/2004

Name and mailing address of the ISA
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB2004/001670

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 139 340 A (BOSCH GMBH ROBERT) 7 November 1984 (1984-11-07) page 2, line 61 - page 3, line 20; figures 3,4 ----- US 4 271 408 A (KISHI YASUNORI ET AL) 2 June 1981 (1981-06-02) column 8, line 16 - column 9, line 4; figures 9,10 -----	3,4,6
		3,4,6

INTERNATIONAL SEARCH REPORT

International Application No

.../GB2004/001670

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 0480650	A	15-04-1992	US	5099192 A		24-03-1992
			DE	69123544 D1		23-01-1997
			DE	69123544 T2		10-04-1997
			EP	0480650 A1		15-04-1992
			HK	91897 A		01-08-1997
			JP	6340114 A		13-12-1994
US 2002014862	A1	07-02-2002	US	2004051482 A1		18-03-2004
			US	2002047649 A1		25-04-2002
			US	6611110 B1		26-08-2003
			AU	2963201 A		24-07-2001
			WO	0152605 A2		19-07-2001
US 4952949	A	28-08-1990		NONE		
GB 2139340	A	07-11-1984	DE	3315785 A1		08-11-1984
			FR	2545195 A1		02-11-1984
			JP	1741955 C		15-03-1993
			JP	4029575 B		19-05-1992
			JP	59209931 A		28-11-1984
US 4271408	A	02-06-1981	JP	1194482 C		12-03-1984
			JP	55053799 A		19-04-1980
			JP	58026079 B		31-05-1983
			JP	55053390 A		18-04-1980
			JP	1194483 C		12-03-1984
			JP	55053800 A		19-04-1980
			JP	58026080 B		31-05-1983
			JP	55053391 A		18-04-1980
			DE	2941634 A1		30-04-1980